

Claims

What is claimed is:

1. A system for finding the instantaneous spatial direction of a source of radio signals comprising
A plurality of antennas;
A plurality of Radio Frequencies receivers, equal the number of antennas;
A plurality of phase digitizers, equal the number of antennas;
Devices to digitally calculate the the phase difference between any two antennas;
Devices to digitally calculate the instantaneous frequency of a detected signal;
Devices to digitally calculate, from frequency and phase differences data, the azimuth to a source of radio signal.
2. A system for finding the instantaneous spatial direction of a source of radio signals as in claim 1, wherein the plurality of antennas is a minimum of two antennas.
3. A system for finding the instantaneous spatial direction of a source of radio signals as in claim 1, wherein each antenna connects to a receiver.
4. A system for finding the instantaneous spatial direction of a source of radio signals as in claim 1, wherein each receiver generates in response to a signal received from an antenna, two sinusoidal output signals at a frequency within the operating bandwidth of half the instruction clock frequency, and wherein the phase difference between the two generated signals is about 90°.
5. A system for finding the instantaneous spatial direction of a source of radio signals as in claim 1, wherein each phase digitizer connects to one receiver, and generates in response to signals received from the receiver a digital output indicative of the instantaneous phase of the signals received from the receiver, at the instance of the transition of an instruction clock pulse.
6. A system for finding the instantaneous spatial direction of a source of radio signals as in claim 1, wherein the devices used to calculate the phase differences between antennas comprise of digital subtractions and adders.
7. A system for finding the instantaneous spatial direction of a source of radio signals as in claim 1, wherein the instantaneous frequency is calculated by digitally obtaining of the phase difference in a signal received, over a span of a single clock period.
8. A system for finding the instantaneous spatial direction of a source of radio signals as in claim 1, wherein the results of frequency and phase differences calculations may be improved by averaging of digital data generated over a plurality of the sampling clock periods.

9. A system for finding the instantaneous spatial azimuth and elevation of a source of radio signals comprising
 - A plurality of antennas on a horizontal plane;
 - An additional antenna;
 - A plurality of Radio Frequencies receivers, equal the number of antennas;
 - A plurality of phase digitizers, equal the number of antennas;
 - Devices to digitally calculate the the phase difference between ant two antennas;
 - Devices to digitally calculate the instantaneous frequency of a detected signal;
 - Devices to digitally calculate, from frequency and phase differences data, the azimuth of a source of radio signal.
10. A system for finding the instantaneous spatial azimuth and elevation of a source of radio signals as in claim 9, wherein the plurality of antennas on a horizontal plane is a minimum of two antennas
11. A system for finding the instantaneous spatial azimuth and elevation of a source of radio signals as in claim 9, wherein an additional antenna is erected on a vertical axis perpendicular to the horizontal plane and common in axis with one antenna on the horizontal plane.
12. A system for finding the instantaneous spatial azimuth and elevation of a source of radio signals as in claim 9, wherein each antenna connects to a receiver.
13. A system for finding the instantaneous spatial azimuth and elevation of a source of radio signals as in claim 9, wherein each receiver generates in response to a signal received from an antenna, two sinusoidal output signals at a frequency within the operating bandwidth of half the sampling clock frequency, and wherein the phase difference between the two signals is about 90°.
14. A system for finding the instantaneous spatial azimuth and elevation of a source of radio signals as in claim 9, wherein each phase digitizer connects to one receiver, and generates in response to signals received from the receiver a digital output indicative of the instantaneous phase of the signals received from the receiver, at the instance of the transition of an instruction clock pulse.
15. A system for finding the instantaneous spatial azimuth and elevation of a source of radio signals as in claim 9, wherein the devices used to calculate the phase differences between antennas comprise of digital subtractions and adders.
16. A system for finding the instantaneous spatial azimuth and elevation of a source of radio signals as in claim 9, wherein the instantaneous frequency is calculated by digitally obtaining of the phase difference in a signal received, over a span of a single sampling clock period.

17. A system for finding the instantaneous spatial azimuth and elevation of a source of radio signals as in claim 9, wherein the results of frequency and phase differences calculations may be improved by averaging of digital data generated over a plurality of sampling clock periods.
18. A system for finding the instantaneous spatial direction of a source of radio signals comprising
Four antennas;
Four Radio Frequencies receivers;
Four phase digitizers;
Devices to digitally calculate the the phase difference between ant two antennas;
Devices to digitally calculate the instantaneous frequency of a detected signal;
Devices to digitally calculate, from frequency and phase differences data, the azimuth of a source of radio signal.
19. A system for finding the instantaneous spatial direction of a source of radio signals as in claim 18, wherein four antennas are mounted on a horizontal plane.
20. A system for finding the instantaneous spatial direction of a source of radio signals as in claim 18, wherein four antennas are mounted on a horizontal plane as two pairs of antennas wherein each pair of antennas is mounted on one common axis, and further wherein the axes of the two pairs of antennas are perpendicular to each other.
21. A system for finding the instantaneous spatial direction of a source of radio signals as in claim 18, wherein each antenna connects to a receiver.
22. A system for finding the instantaneous spatial direction of a source of radio signals as in claim 18, wherein each receiver generates in response to a signal received from an antenna, two sinusoidal output signals at a frequency within the operating bandwidth of half the sampling clock frequency, and wherein the phase difference between the two signals is about 90°.
23. A system for finding the instantaneous spatial direction of a source of radio signals as in claim 18, wherein each phase digitizer connects to one receiver, and generates in response to signals received from the receiver a digital output indicative of the instantaneous phase of the signals received from the receiver, at the instance of the transition of an instruction clock pulse.
24. A system for finding the instantaneous spatial direction of a source of radio signals as in claim 18, wherein the devices used to calculate the phase differences between antennas comprise of digital subtractions and adders.
25. A system for finding the instantaneous spatial direction of a source of radio signals as in claim 18, wherein the instantaneous frequency is calculated by digitally obtaining of the phase difference in a signal received, over a span of a single sampling clock period.

26. A system for finding the instantaneous spatial direction of a source of radio signals as in claim 18, wherein the results of frequency and phase differences calculations may be improved by averaging of digital data generated over a plurality of clock periods.
27. A system for finding the instantaneous spatial azimuth and elevation of a source of radio signals comprising
 - Four antennas on a horizontal plane;
 - An additional antenna;
 - Five Radio Frequencies receivers;
 - Five phase digitizers;
 - Devices to digitally calculate the the phase difference between ant two antennas;
 - Devices to digitally calculate the instantaneous frequency of a detected signal;
 - Devices to digitally calculate, from frequency and phase differences data, the azimuth of a source of radio signal.
28. A system for finding the instantaneous spatial azimuth and elevation of a source of radio signals as in claim 27, wherein four antennas are mounted on a horizontal plane as two pairs of antennas wherein each pair of antennas is mounted on one common axis, and further wherein the axes of the two pairs of antennas are perpendicular to each other.
29. A system for finding the instantaneous spatial azimuth and elevation of a source of radio signals as in claim 27, wherein an additional antenna is erected on a vertical axis perpendicular tp the horizontal plane and common with one antenna on the horizontal plane .
30. A system for finding the instantaneous spatial azimuth and elevation of a source of radio signals as in claim 27, wherein each antenna connects to a receiver.
31. A system for finding the instantaneous spatial azimuth and elevation of a source of radio signals as in claim 27, wherein each receiver generates in response to a signal received from an antenna, two sinusoidal output signals at a frequency within the operating bandwidth of half the sampling clock frequency, and wherein the phase difference between the two signals is about 90°.
32. A system for finding the instantaneous spatial azimuth and elevation of a source of radio signals as in claim 27, wherein each phase digitizer connects to one receiver, and generates in response to signals received from the receiver a digital output indicative of the instantaneous phase of the signals received from the receiver, at the instance of the transition of an instruction clock pulse.
33. A system for finding the instantaneous spatial azimuth and elevation of a source of radio signals as in claim 27, wherein the devices used to calculate the phase differences between antennas comprise of digital subteractors and adders.

34. A system for finding the instantaneous spatial azimuth and elevation of a source of radio signals as in claim 27, wherein the instantaneous frequency is calculated by digitally obtaining of the phase difference in a signal received, over a span of a single sampling clock period.
35. A system for finding the instantaneous spatial azimuth and elevation of a source of radio signals as in claim 27, wherein the results of frequency and phase differences calculations may be improved by averaging of digital data generated over a plurality of sampling clock periods.
36. A system for finding the instantaneous spatial direction of a source of radio signals comprising
 - Two directional antennas;
 - Two radio signals receivers, equal the number of antennas;
 - Two phase digitizers, equal the number of antennas;
 - Devices to digitally calculate the the phase difference between the two antennas;
 - Devices to digitally calculate the instantaneous frequency of a detected signal;
 - Devices to digitally calculate, from frequency and phase differences data, the azimuth of a source of radio signal.
37. A system for finding the instantaneous spatial direction of a source of radio signals as in claim 36, wherein each antenna connects to a receiver.
38. A system for finding the instantaneous spatial direction of a source of radio signals as in claim 36, wherein each receiver generates in response to a signal received from an antenna, two sinusoidal output signals at a frequency within the operating bandwidth of half the sampling clock frequency, and wherein the phase difference between the two signals is about 90°.
39. A system for finding the instantaneous spatial direction of a source of radio signals as in claim 36, wherein each phase digitizer connects to one receiver, and generates in response to signals received from the receiver a digital output indicative of the instantaneous phase of the signals received from the receiver, at the instance of the transition of an instruction clock pulse.
40. A system for finding the instantaneous spatial direction of a source of radio signals as in claim 36, wherein the devices used to calculate the phase differences between antennas comprise of digital subtractors and adders.
41. A system for finding the instantaneous spatial direction of a source of radio signals as in claim 36, wherein the instantaneous frequency can be calculated by digitally obtaining of the phase difference in a signal received, over a span of a single sampling clock period.
42. A system for finding the instantaneous spatial direction of a source of radio signals as in claim 36, wherein the results of frequency and phase differences calculations may be

improved by averaging of digital data generated over a plurality of the sampling clock periods.

43. An instantaneous phase digitizer comprising:
Two input buffers one for each of the two quadrature related sinusoidal input signals;
Two resistive networks each comprised of $n-1$ resistors having n taps;
An array of n comparators each having two differential inputs wherein one input connects to one tap on one resistive network and wherein the other input connects to one tap on the other resistive network;
An array of n flip-flops each having a data input connecting to one output of a comparator and wherein a sampling clock connects to clock inputs all n flip-flops;
An array of Exclusive OR gates connecting to the outputs of the flip-flops to generate a digital code
44. An instantaneous phase digitizer as in claim 43 wherein the resistive networks in combination with the differential comparators are used to perform n vectorial summations on fractions of the two quadrature sinusoidal inputs to yield n squarewave signals each shifted in phase by $360^\circ/n$ with respect to other $n-1$ squarewaves.
45. An instantaneous phase digitizer as in claim 43 wherein n flip-flops each receiving one of n squarewaves on its D input and samples that signal on the instance of the transition of the sampling clock.
46. An instantaneous phase digitizer as in claim 43 wherein exclusive-or function gates are used to convert the outputs of n flip-flops to $G = \log_2 n$ Grey code bits and to same number of Binary code bits.
47. A phase measurement system to be used in a Monopulse type radar system comprising an instantaneous phase digitizer as in claim 43.
48. A phase measurement system to be used in a CROSS-EYE type radar deception system comprising an instantaneous phase digitizer as in claim 43.